

ORIGINAL ARTICLE

Different working and living conditions and their associations with persistent neck/shoulder and/or low back disorders

Ola Leijon, Per Lindberg, Malin Josephson, Christina Wiktorin

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See end of article for authors' affiliations

Correspondence to:
Dr O Leijon, Department of
Occupational and
Environmental Health,
Stockholm Centre for Public
Health, Norrbacka, SE-171
76 Stockholm, Sweden;
ola.leijon@sl.se

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Objectives: To investigate whether different combinations of working and living conditions are associated with the risk for persistent neck/shoulder and/or low back disorders. The underlying purpose of this contextual approach was to identify target groups for primary/secondary prevention.

Methods: In a baseline study, 11 groups with different working and living conditions were identified by cluster analysis. In this study, these 11 groups were followed up by a postal questionnaire 5 years after baseline (response rate 82%, n = 1095).

Results: Five of the groups—the onerous human services job, the free agent, the family burden, the mentally stretched and the physically strained groups—had an increased risk for persistent disorders (OR 2.38–2.70). Four of these groups had rather sex-specific working and living conditions.

Conclusions: The results support the hypothesis that different combinations of working and living conditions may increase the risk for persistent neck/shoulder and/or low back disorders to different degrees. Sex-specific working and living conditions increased the risk for women as well as for men, irrespective of whether the conditions were specific to women or men.

Substantial evidence shows that the neck/shoulder region and the lower back are the most affected body parts with regard to musculoskeletal disorders (MSDs). These disorders are the most frequent sources of complaints of pain, health care utilisation, lost work time and early retirement.^{1,2} The sizeable number of people having neck/shoulder or low back disorders underscores the societal importance of the problem, emphasising an urgent need for effective strategies to deal with it.

The basis in prevention of MSDs is a sound foundation of knowledge, which must include the identification of risk factors contributing to MSDs as well as the identification of individuals or groups—for example occupational groups—exposed to these risk factors.^{3–11} However, this approach has often led to prevention strategies that focus on one single domain—that is, work or non-work factors—even though the multifactorial causes and complexity of MSDs are often emphasised.¹¹

To counterbalance the somewhat limited perspective of single risk-factor modification, primary/secondary prevention strategies tailored to the needs of the individual and considering the individual's whole working and living conditions have been recommended.¹² For this a more contextual approach, working as well as living conditions, and strain-inducing factors as well as supportive factors, should be appraised.^{13,14} Consequently, there is a need to identify groups with similar working and living conditions and to explore whether, in the long term, different combinations of working and living conditions are associated with MSDs to different degrees. The identification of such risk groups for MSDs may facilitate a selective prevention approach, allowing us to match and market the most suitable broad-based preventive actions to the most appropriate target group.

In a previous study, we applied a person-oriented approach on a dataset of 1332 gainfully employed men and women who had not sought care for neck/shoulder or low back disorders during the 6 months before enrolment in the study.¹⁵ Eleven groups with different combinations of working and living conditions were identified by cluster analysis of 15 variables on

ergonomic physical and psychosocial work factors, and factors in the private sphere. Personal factors such as sex were not included in the formation of the clusters. Two of the clusters were dominated by women and two by men ($\geq 70\%$ of one sex), whereas seven clusters had a more even distribution of men and women. The clusters dominated by men and women indicated rather sex-specific working and living conditions (see table in appendix).

The aim of this study was to follow-up these 11 groups after a 5-year period, in order to compare the groups and investigate which working and living conditions might be associated with persistent disorders in the neck/shoulder and/or low back. The underlying purpose was to identify target groups for prevention of such disorders, which, in turn, would facilitate a selective primary/secondary prevention approach.

PARTICIPANTS AND METHODS

Participants

This study population consisted of referents from a population-based case-referent study aimed to identify and quantify risk factors and protective factors for neck/shoulder and low back disorders, the Musculoskeletal Intervention Center (MUSIC)-Norrköping Study, comprising approximately 17 000 men and women, aged 20–59 years, from the Swedish municipality of Norrtälje.^{16,17} The 1707 referents in the MUSIC-Norrköping Study were matched to the cases in the study and randomly selected from the study population by means of the population register with regard to sex and age (5-year categories), and had not sought care or been treated for neck/shoulder or low back disorders during the 6 months preceding enrolment in the baseline study. Hence, the referents were assumed to be people who did not have any severe disorders in the neck/shoulder region or in the low back.

In a previous study, we had excluded referents who were not in long-term regular or temporary employment—that is, those who during the 12 months preceding baseline had worked

Abbreviations: MSDs, musculoskeletal disorders; MUSIC, Musculoskeletal Intervention Center; VDU, video display unit

<17 h/week.¹⁵ Among the remaining 1332 participants, 11 groups with different working and living conditions were identified by cluster analysis (see table in appendix). For a detailed description of the groups, see Leijon *et al.*¹⁵

This study was approved by the ethical committee at the Karolinska Institutet (DNr 93-255).

Baseline measurements

Baseline measurements of exposure, performed between 1994 and 1997, were used to form and describe the 11 groups (clusters).¹⁵ Measurements included two structured interviews on physical and psychosocial exposures at and outside work, and a self-administered questionnaire. The two interviews were performed by an ergonomist and a behavioural scientist. The questionnaire included 12 questions with a response scale of 0–10, three on pain intensity and three on pain-related disability in the neck/shoulder region, and the same questions regarding the low back region (fig 1).¹⁸ For each body region and separately for each participant, average values for the questions on pain intensity and on pain-related disability were calculated. If a participant had an average value ≥ 3 for pain intensity and/or an average value ≥ 1 for pain-related disability in the corresponding body part, this participant was classified as having a disorder in that body part.

Follow-up measurements

A postal questionnaire was sent to each participant 4–6 years after the baseline measurements. Participants examined in 1994 or 1995 received their follow-up questionnaire in 2000, and those examined in 1996 or 1997 received theirs in 2001. Two thirds (69%) of the subjects were followed up 5 years after their baseline investigation, 4% after 4 years and 27% after 6 years. Up to three reminders were posted.

The follow-up questionnaire repeated the same 12 questions on pain intensity and pain-related disability in the neck/shoulder and low back (fig 1).¹⁸ As in the baseline measurements, participants were classified as having or not having neck/shoulder or low back disorders (disorder/no disorder). Participants were also asked whether they had sought care for pain in the neck/shoulder (yes/no) or low back (yes/no) during the follow-up period: Have you on any occasion in the past 5 years sought care for pain in the neck/shoulder (low back)? Those who responded in the affirmative were classified as having sought care.

In addition, data on job titles at follow-up, work-related changes over the past 5 years and family situation at follow-up were collected in the follow-up questionnaire.

Outcome

The outcome was defined by neck/shoulder and/or low back pain at baseline, neck/shoulder and/or low back pain at follow-up and having sought care for pain during the follow-up period. These three variables together resulted in eight different outcome combinations (fig 2). From these eight combinations, two outcome groups were constructed: the “absence of disorders” and “persistent disorders” groups. The absence of disorders group had no pain either at baseline or at follow-up, and had not sought care during the follow-up period. The persistent disorders group had had pain at baseline and at follow-up, and had sought care for the pain during the follow-up period. The remaining six combinations had experienced pain at some point (at baseline or at follow-up) and/or had sought care during the follow-up period. The group was thus heterogeneous and was excluded in the following analyses.

Statistical analysis

Logistic regression analyses were performed to determine whether different combinations of working and living conditions (the 11 clusters) were associated with persistent disorders. The sedentary work group (cluster 4) had a highest proportion of participants with absence of disorders (50%), and was used as the reference group. In the analyses, participants with absence of disorders was used as a comparison group. Sex (male/female) and age group (<31 years/31–44 years/>44 years) were considered as potential confounders. In the first step, crude odds ratios (ORs) for the association between working and living conditions and persistent disorders were calculated. In the second step, two separate analyses were performed and each analysis included one of the potential confounders. A >20% change of the adjusted OR compared with the crude OR was considered as confounding. All statistical analyses were conducted using SPSS V.13.0 for Windows.

RESULTS

The overall response rate of the follow-up questionnaire was 82%, leaving a total of 1095 participants for analysis. There was no significant difference in the response rate between the 11 groups (range 75–86%, Pearson's χ^2 $p = 0.31$). Table 1 presents the number of participants in each of the 11 groups with different combinations of working and living conditions. The mean (standard deviation (SD)) age of all participants was 48.1 years (9.6), range 25–64 years, and the mean age varied from 43.3 to 50.5 years for the 11 groups.

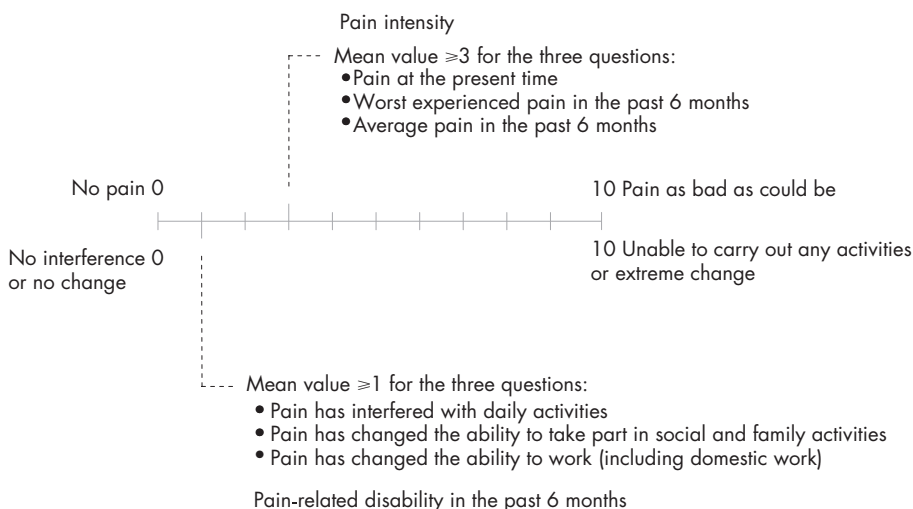


Figure 1 Participants answered three questions on pain intensity and three questions on pain-related disability in the neck/shoulder and low back region.¹⁸ Participants with an average value ≥ 3 for pain intensity and/or an average value ≥ 1 for pain-related disability in the corresponding body part were classified as having a disorder in that body part.

		Sought care		Not sought care	
		Pain at 5-year follow-up	No pain at 5-year follow-up	Pain at 5-year follow-up	No pain at 5-year follow-up
Pain at baseline	Persistent disorders (n = 188)		(n = 38)	(n = 95)	(n = 102)
No pain at baseline		(n = 99)	(n = 75)	(n = 86)	Absence of disorders (n = 412)

Figure 2 The presence/absence of pain in the neck/shoulder or low back at baseline and at follow-up among those who had sought care/not sought care during the follow-up period resulted in eight different combinations. From these eight combinations, two outcome groups were constructed for analysis: the persistent disorders and absence of disorders groups.

Among the respondents, 85% reported that they had worked in the same type of job and had worked continuously during the follow-up period. The main reasons for changed working conditions during the follow-up period were a switch to part-time work, a period of parental leave or studies. At follow-up, 70% of participants had the same family situation as at baseline. The most common changes in family situation were that children had moved out of the parents' home, a change of marital status or a change from living without to living with children.

At baseline, 423 of the 1095 (39%) participants had neck/shoulder or low back pain. At follow-up, 468 (43%) participants had neck/shoulder or low back pain, and 400 (37%) had sought care for such pain during the follow-up period (fig 2). The distributions differed for women and men (not shown in fig 2). A larger proportion of women than of men had neck/shoulder or low back pain at baseline (40% v 35%, respectively), a larger proportion of women than men (47% v 38%) had pain at follow-up and a larger proportion of women than of men (41% v 31%) had sought care for the pain during the follow-up period.

Classified into the two outcome groups, 188 (17%) participants had persistent disorders and 412 (38%) participants had absence of disorders (table 2). The distributions differed for women and men (not shown in table 2). A larger proportion of women (20%) than of men (13%) had persistent disorders, and a smaller proportion of women (34%) than of men (42%) had absence of disorders. For the 11 groups with different

Table 1 Number of participants in the 11 clusters, and proportion of men and women in each cluster

Cluster	All participants (n)	Women (%)	Men (%)
1. Onerous human services job	140	70	30
2. Free agent	69	22	78
3. Family burden	130	87	13
4. Sedentary work	101	56	44
5. Passive	82	61	39
6. Mentally stretched	129	53	47
7. Balanced	165	56	44
8. Physically active	42	45	55
9. Manual colourless labour	111	59	41
10. Shift work	66	67	33
11. Physically strained	60	12	88
Total	1095		

combinations of working and living conditions, the proportion of participants with persistent disorders varied from 7% to 22%, and that of participants with absence of disorder varied from 30% to 50% (see table 2 for number of participants).

The initial logistic regression analyses showed that age did not confound the association between different combinations of working and living conditions, and persistent disorders. Consequently, the subsequent analyses were adjusted only for sex (table 2). After adjusting for sex, the analyses showed that four of the groups—the onerous human services job group, the free agent group, the family burden group and the mentally stretched group—had an increased risk for persistent disorders (OR 2.38–2.65) compared with the sedentary work group. There was also a tendency that the physically strained group had an increased risk for persistent disorders (OR 2.7, 95% CI 0.96 to 7.62).

DISCUSSION

The results of this study showed that some combinations of working and living conditions were more strongly associated with persistent neck/shoulder and low back disorders. Consequently, some combinations of working and living conditions should be targets for primary/secondary prevention.

Neck/shoulder and low back disorders are complex phenomena with many potential causes, including some that are still not fully understood. A substantial body of scientific evidence suggests that several aspects of work may contribute to the genesis of MSDs. The relative risk for getting neck/shoulder disorders has also been shown to increase with an increasing number of risk indicators.¹⁹ However, high-quality long-term prospective studies with convincing evidence for outside-work factors predicting neck or low back disorders are still lacking.²⁰ The complexity of MSDs implies that new strategies are needed

Table 2 Association between different combinations of working and living conditions (the 11 clusters) and persistent neck/shoulder or low back disorders.

Cluster	Included in the analysis (n)		OR (95% CI)
	Absence of disorders group*	Persistent disorders group†	
1. Onerous human services job	45	27	2.39 (1.08 to 5.31)
2. Free agent	21	13	2.55 (1.36 to 9.3)
3. Family burden	39	29	2.65 (1.19 to 5.9)
4. Sedentary work	51	12	1, Reference
5. Passive	33	14	1.84 (0.75 to 4.51)
6. Mentally stretched	48	25	2.38 (1.07 to 5.32)
7. Balanced	67	28	1.83 (0.84 to 3.98)
8. Physically active	20	3	0.75 (0.19 to 2.98)
9. Manual colourless labour	37	17	1.97 (0.84 to 4.66)
10. Shift work	31	11	1.49 (0.58 to 3.81)
11. Physically strained	20	9	2.7 (0.96 to 7.62)
Total	412	188	

ORs and 95% CIs, adjusted for gender, are presented.

*No pain at baseline or at follow-up, and not having sought care during the 5-year follow-up period.

†Pain at baseline and at follow-up, and having sought care for the pain during the 5-year follow-up period.

to prevent these disorders. In this study, we applied a person-oriented approach, in which we considered working and living conditions of the individual, to identifying target groups for primary/secondary prevention.

Several arguments are in favour of a broad-based prevention approach of identifying target groups for prevention of neck/shoulder and low back disorders, as opposed to the modification of the single risk-factor approach. Firstly, as the causes of neck/shoulder and low back disorders are multifactorial, modifying a single risk factor will not necessarily be successful. Secondly, the division of MSDs into “work-related” or “non-work-related” disorders is unclear as the fraction of MSDs attributable to work-related factors is still not well established.²¹ In practice, it is almost impossible to distinguish disorders “caused” by work from disorders “caused” by factors outside work, just as it is almost impossible to distinguish disorders “caused” by factors or conditions in the private sphere. Frank *et al*²² conclude that a simplistic attribution of the problem to one class of factors is unwarranted and unhelpful. Thirdly, the same levels of exposure may have a different effect on different individuals or groups, as different risk factors and/or supportive or protective factors at work and in the private sphere may be entangled in different ways for different individuals, and also may change over the lifespan for the individual. This is, for example, underscored by the rapid changes and variations in the working life where the exposure changes continuously.²³ In addition to these arguments, the natural course of neck/shoulder and low back disorders is extremely variable, with a wide range of consequences (for the individual, the employer and the society) among cases that initially seem to be similar.^{24–25}

In light of the above, what are the implications of the findings of this study? Our results showed that four of the groups, the onerous human services job group, the free agent group, the family burden group and the mentally stretched group, had an increased risk for persistent disorders. In addition, the physically strained group also had an increased risk (OR 2.7), but did not reach the significance level. In all these groups, there is an obvious need for early identification of and prevention of individuals with risk for chronicity. Interestingly, but perhaps not very surprisingly, four of the five groups were among those with the most skewed distributions of women and men. The onerous human services job and family burden groups contained largely women (70% and 87%, respectively) working in the human services or service branch. The free agent and physically strained groups consisted mainly of men (78% and 88%, respectively) working in the production branch. Moreover, for the onerous human services job group, strenuous psychosocial work conditions were the most prominent feature, with high psychological demands and many hindrances that were not balanced with high influence over work. The family burden group had to cope especially with high demands in the private sphere with much time for domestic and family work. In the male-dominated free agent and physically strained groups, the most prominent feature was high physical workload during long work hours. The free agent group also had strenuous psychosocial work conditions with high psychological demands and many hindrances. Consequently, these working and living conditions were fairly sex-specific, and we can conclude that, in this study, sex-specific conditions were associated with a higher risk for neck/shoulder and low back disorders. The results support the assumptions presented by Kilbom and Messing,²⁶ that sex-specific life situations are probably more important than any biological differences in explaining sex differences in MSDs. Another study has shown that exposure differences may be strongly associated with vertical occupational segregation,

especially in female-dominated jobs.²⁷ The results of this study imply that we carefully need to consider what broad-based prevention strategies are needed. In other words, what concurrent preventive interventions at different levels are needed—for example, at the individual/family level, at the work place level and at the societal level?

The arguments for broad-based prevention also concern the mentally stretched group. By contrast, this group had a fairly even sex distribution, and worked in many different branches. The mentally stretched group had a work situation including the highest psychological demands and the most hindrances at work of all groups—a work situation that may lead to very high levels of stress. Previous studies have shown that a workload accompanied by high levels of stress may be associated with symptoms such as MSDs.^{28–29}

Although the aim of this study was to identify target groups for prevention, and not to investigate which preventive interventions to use, the results may generate some general ideas on prevention strategies, such as to reduce psychological demands or improve the individual's stress-coping skills, lower physical stress and enable sufficient recuperation between both strenuous work tasks and work shifts, and to improve the balance between job and leisure time. Furthermore, long-term prevention strategies both at the workplace level and at the organisational level also need to be considered to improve the overall work situation. However, in preventive work it is probably not possible to target the groups outlined in the paper. A fruitful way of using the results might be to present and discuss the different clusters for groups of workers at different workplaces. The results often raise questions such as “Which group (cluster) do I belong to?” and “What can I do to change from a risk group to a healthy group?”

Six of the groups were not associated with persistent disorders. It is noteworthy that these “healthy” groups were found in all branches of the labour market, and that they represented a wide variety of occupations and did not only represent physically and psychosocially non-strenuous jobs or just one type of situation in the private sphere. Nor did they have reversed working and living conditions in relation to the groups with increased probability for disorder. Mackenbach *et al*³⁰ stated more than 10 years ago that this research field is poorly investigated. Relatively few studies have been presented since then. The findings in our study suggest that the patterns of working and living conditions associated with the presence or absence of MSDs are complex. Nevertheless, they also suggest that all six “healthy” groups had working and living conditions that seemed to be balanced in one way or another with regard to work-related and/or outside-work factors. However, health-promoting factors or working and living conditions and MSDs are beyond the scope of this study, and we can only conclude by stating that further research in the field is essential for future prevention strategies.

Finally, it is worth mentioning that there is considerable potential for primary/secondary prevention to reduce the incidence of neck/shoulder and low back disorders as well as the consequences of these disorders. In this study, we argue for

Main messages

- Sex-specific working and living conditions were associated with neck/shoulder and low back disorders.
- Cluster analysis of variables on working and living conditions seems to be a practicable method for identifying target groups for primary/secondary prevention.

Policy implications

- The results of this study support a selective public health approach in prevention aimed at reducing neck/shoulder and low back disorders.
- Broad-based strategies considering the individuals' whole working and living conditions need to be implemented in the planning, accomplishment and evaluation of preventive efforts.

the importance of a contextual approach to identifying the target groups for prevention and, therefore, also for broad-based preventive strategies. Cluster analysis of working and living conditions seems to be a practicable method for identifying such target groups for prevention. However, further research is needed to investigate how preventive interventions can be implemented in such groups.

Methodological considerations

The study group was a sample of referents from the MUSIC-Norrköping Study and included working participants in long-term regular or temporary employment. Moreover, the participants had not sought care during the 6 months preceding enrolment in the baseline study. Pain, or pain-related disability, due to MSDs was not an exclusion criterion and a fairly large proportion of the participants had such problems at baseline without having sought care. The selection of the sample was made to (i) resemble a potential target group for primary/secondary prevention—that is, a group with absence or a low level of symptoms; and (ii) ensure high data quality by using a group confident with their exposures through at least 12 months' work experience. The results showed that most participants (85%) had remained in the same type of job during the follow-up period. However, other population groups can also be potential targets for prevention—for example, students, unemployed people and short-term employees. These groups were not included in the study sample owing to the methods applied, as cluster analysis requires a full set of data on all variables.

In this study, neck/shoulder and low back disorder was defined as pain and/or pain-related disability.¹⁸ A participant was defined as having such a disorder if the average pain intensity score was ≥ 3 and/or the average pain-related disability score was ≥ 1 . The cut-off points were chosen on the basis of the distribution of the scores given by all participants (cases and referents) in the follow-up study, and correspond to the upper tertile. The proportions of participants with neck/shoulder or low back disorder (table 1) correspond to many of the estimates presented in a large number of studies.^{31–32} The relatively low value of the cut-off points is motivated by the aim of the study—that is, to identify potential target groups for primary/secondary prevention (not tertiary prevention). In addition, several studies have shown that previous episodes of pain are a risk factor for future episodes of pain as well as for persistent pain.³³

The outcomes, in turn, were defined by disorders at baseline, disorders at follow-up and having sought care during the follow-up period. We argue that the classification of the outcome into persistent disorders or absence of disorders is relevant from a prevention perspective.

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Authors' affiliations

Ola Leijon, Christina Wiktorin, Division of Occupational Medicine, Department of Public Health Sciences, Karolinska Institutet, Stockholm, Sweden

Per Lindberg, Section of Personal Injury Prevention, Department of Clinical Neuroscience, Karolinska Institutet, Stockholm, Sweden

Malin Josephson, Occupational and Environmental Medicine, Department of Medical Sciences, Uppsala University, Uppsala, Sweden

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APPENDIX

Short description of what characterised the 11 clusters with regard to the 15 variables included in the cluster analysis. For each variable, the three highest and three lowest mean values or proportions are indicated¹⁵

Cluster	Main characteristics of the clusters		Where are the clusters found in the working life?
	Work sphere (12 variables)	Private sphere (3 variables)	
1. Onerous human services job	High psychological demands Many hindrances Much creativity; few routine tasks Low physical demands	Much time for own recreation Low metabolic demands Little domestic and family work	Human services Public sector Working with people
2. Free agent	Long work hours; high influence High physical demands High psychological demands Many hindrances	Little time for own recreation Little domestic and family work Low metabolic demands	Production branch; self-employment private sector; working with things Sex-segregated jobs Regular employment Low/medium income
3. Family burden	Short work hours Much social interactions Low/moderate physical demands	Much domestic and family work High metabolic demands	Human services; service branch Working with people Temporary employment Low/medium income
4. Sedentary work	Much VDU work Low physical demands Office hours Much creativity; few routine tasks	Low metabolic demands	Service branch Private sector Working with data Sex-integrated jobs Regular employment
5. Passive	Much social interactions Low psychological demands; low influence Few hindrances; no office hours Low/moderate physical demands Many routine tasks; little creativity	Much domestic and family work Much time for own recreation	Human services Transport/communication branch Public sector; working with people Sex-segregated jobs Temporary employment
6. Mentally stretched	High psychological demands Many hindrances Much creativity; few routine tasks Long work hours; low physical demands High influence	Little time for own recreation	Different branches Public sector; working with people Sex-integrated jobs Regular employment High income
7. Balanced	Much social interaction; high influence Low psychological demands Few hindrances Moderate physical demands	—	Different branches Working with people
8. Physically active	No office hours	High metabolic demands Little domestic and family work Little time for own recreation	Different branches Working with people Sex-integrated jobs Temporary employment High income
9. Manual colourless labour	Many routine tasks; little creativity Little social interactions; office hours Short work hours; High physical demands Low psychological demands Few hindrances; low influence	Much time for own recreation	Service branch Production branch Working with things Low/medium income
10. Shift work	Little social interactions No office hours; short work hours Much VDU work Low influence Many routine tasks; little creativity	Much domestic and family work; high metabolic demands	Production branch Human services Working with things High income
11. Physically strained	High physical demands Long work hours; office hours Little social interactions	—	Production branch Private sector Working with things Sex-segregated jobs

VDU, visual display unit

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